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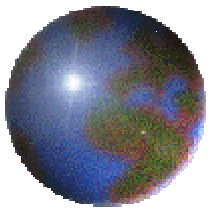

Positron Production from a Tungsten Single Crystal at the KEK 8-GeV Electron Linac

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1. Purpose of the Experiment

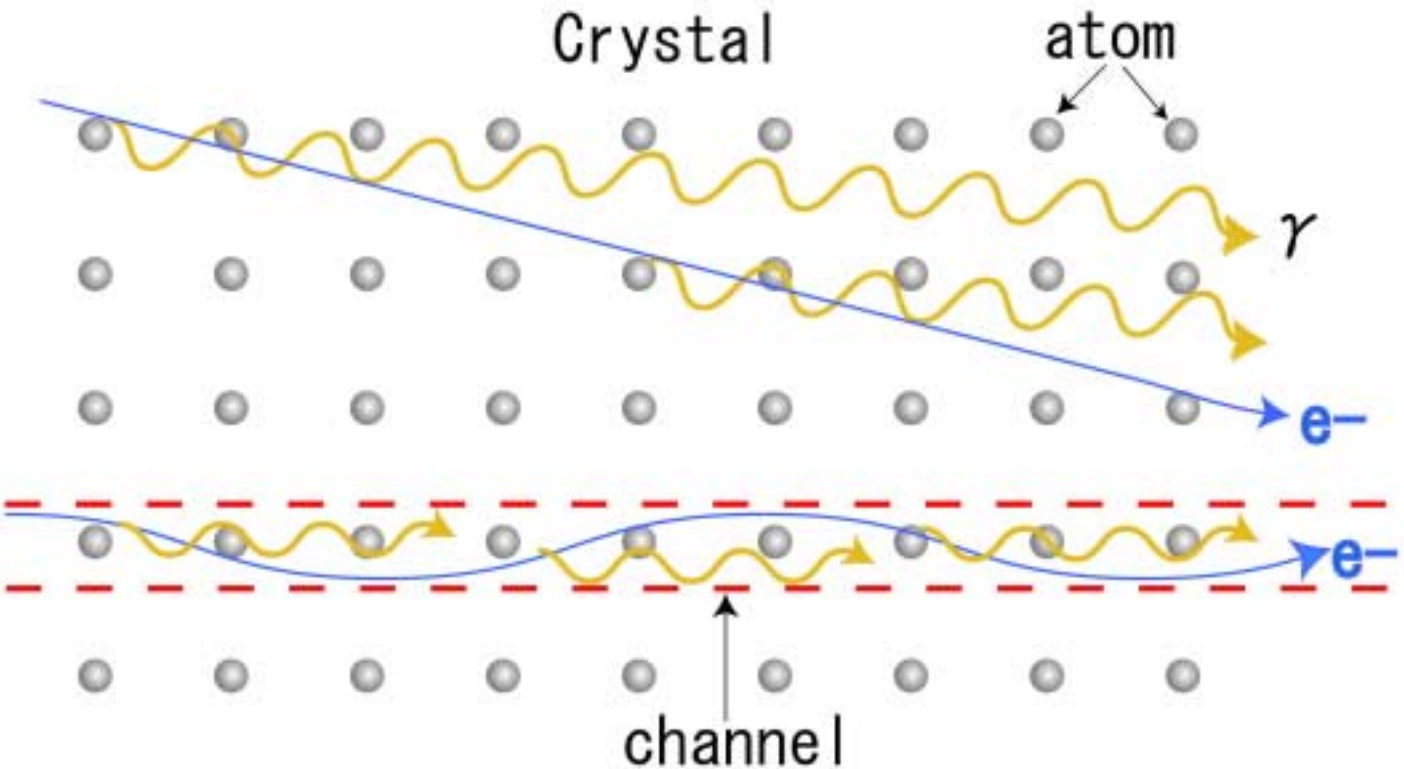
Study of the possibility of using a tungsten (W) single crystal as a target for positron production in a linear accelerator

- Increase of the positron production efficiency
- Optimum target thickness, etc…

⇒ Application to KEKB and future Linear Colliders

2. Principle

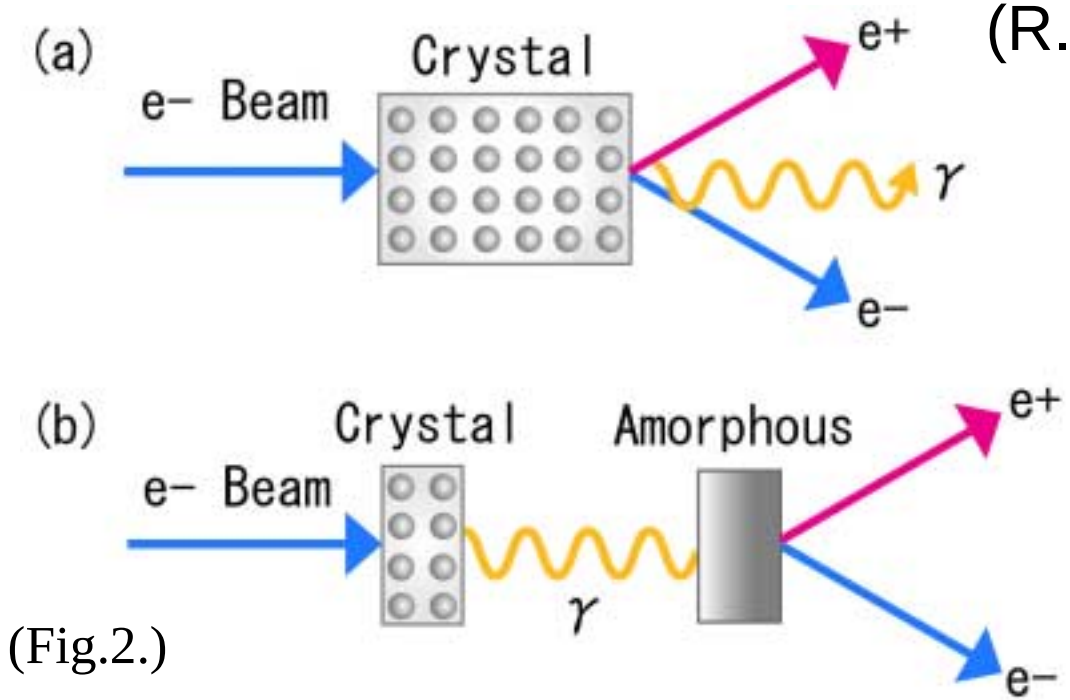
Coherent Bremsstrahlung and Channeling Radiation



(Fig.1.)

3. The Method Using a Single Crystal

(R.Chehab et al.)

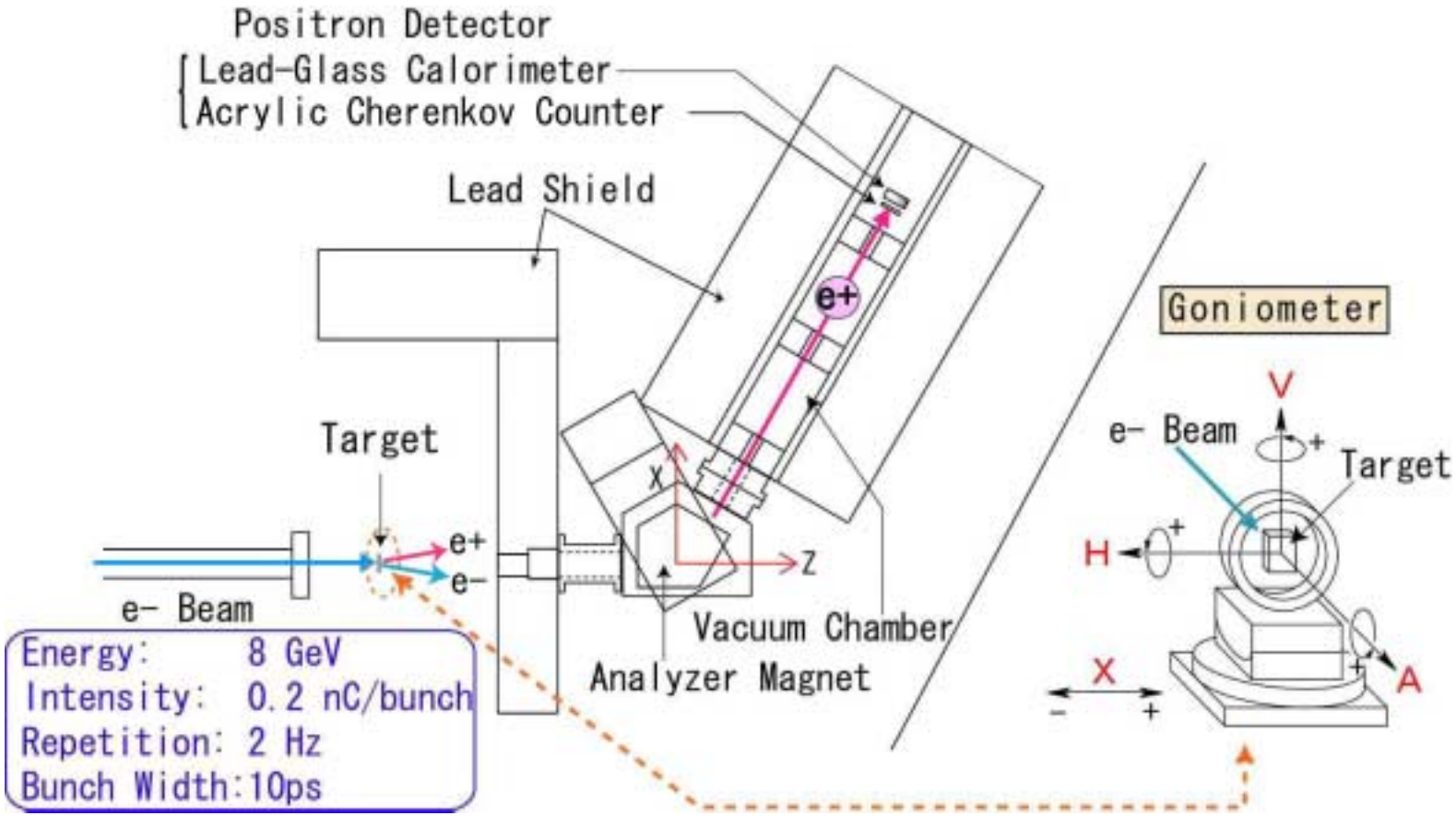


(Fig.2.)

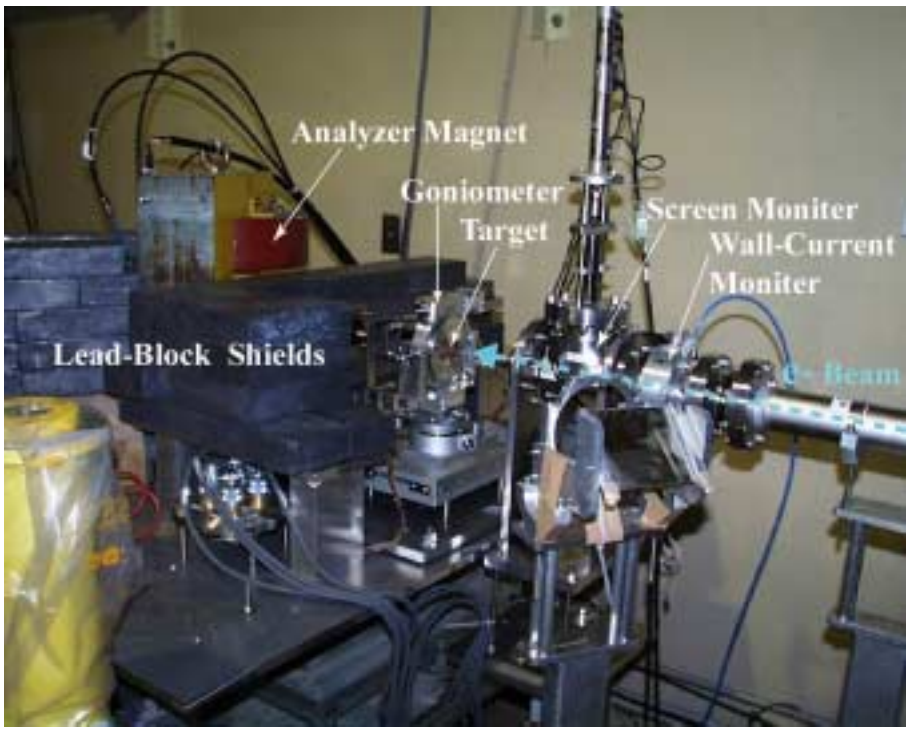
(a) Radiation and pair creation in one crystal
(b) Radiation in the front crystal and pair creation in the amorphous converter

4. Experiment at the KEK 8-GeV Linac

(1) Experimental Method and Apparatus

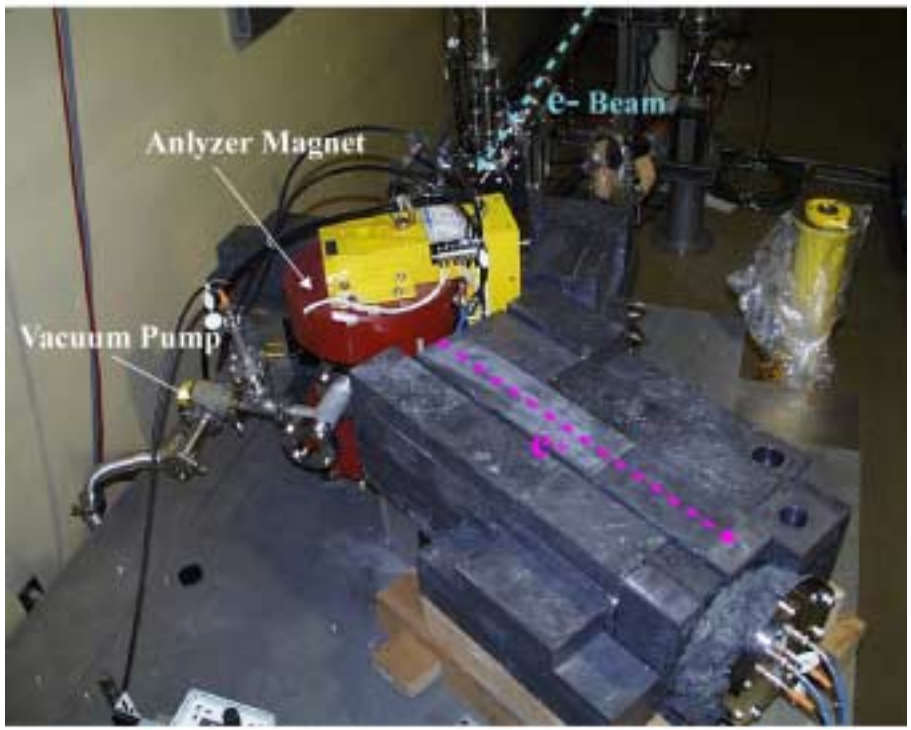


(Fig.3.)



Front View

Rear View



(Fig.4.)

(2) Condition

- Incident Electron Beam

Energy:	8 GeV
Intensity:	0.2 nC/bunch (~10^9e-)
Repetition:	2 Hz
Bunch Width:	10 ps
Beam Size at Target:	1.5 mmϕ
Beam Divergence:	15 μ rad (Vertical)
	72 μ rad (Horizontal)

- Target for Positron Production

Tungsten Single Crystal : <111>axis
2.2 mm (Mosicity:1.5mrad) & 9 mm (Mosicity:0.5mrad)
Tungsten Amorphous: 0~18 mm

- Positron Spectrometer

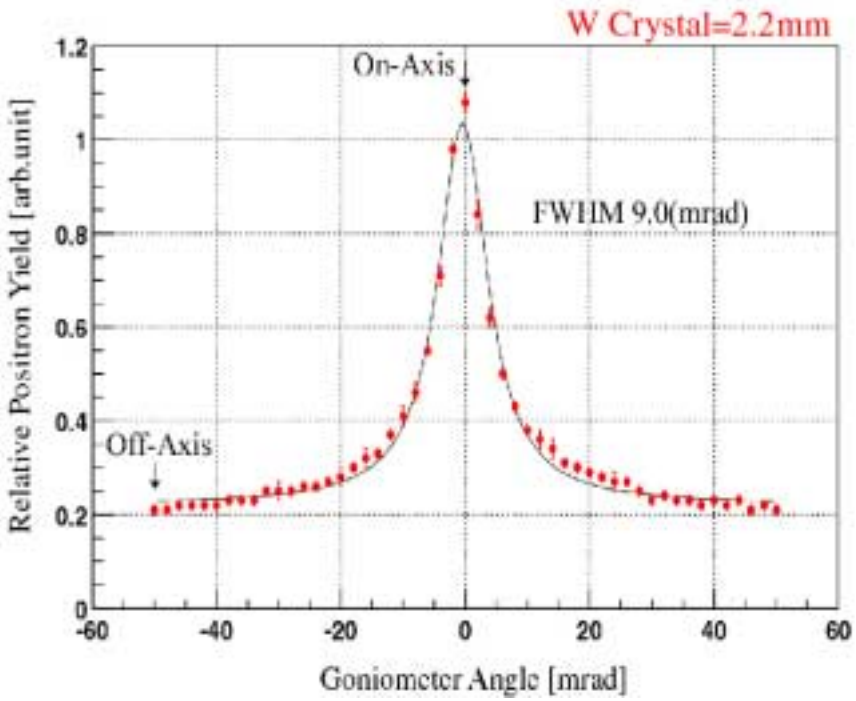
Pe+ [MeV/c]	Acceptance [MeV/c·Steradian]
10	2.47×10^{-4}
15	3.80×10^{-4}
20	4.81×10^{-4}

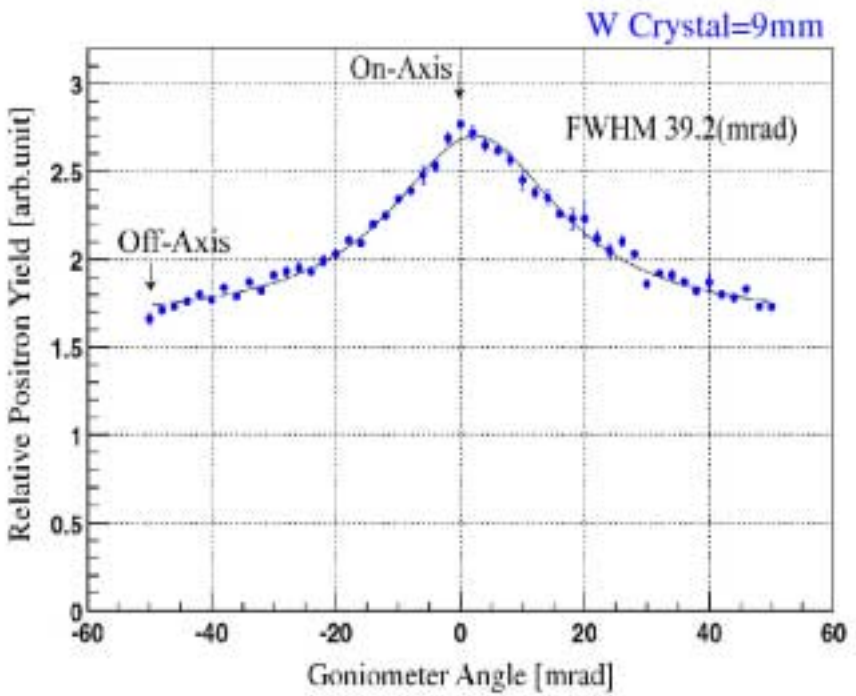
- Positron Detector

Acrylic Cherenkov Counter, Lead-Glass Calorimeter

5. Experimental Results

(1) Rocking Curve for Pe_+=20MeV/c



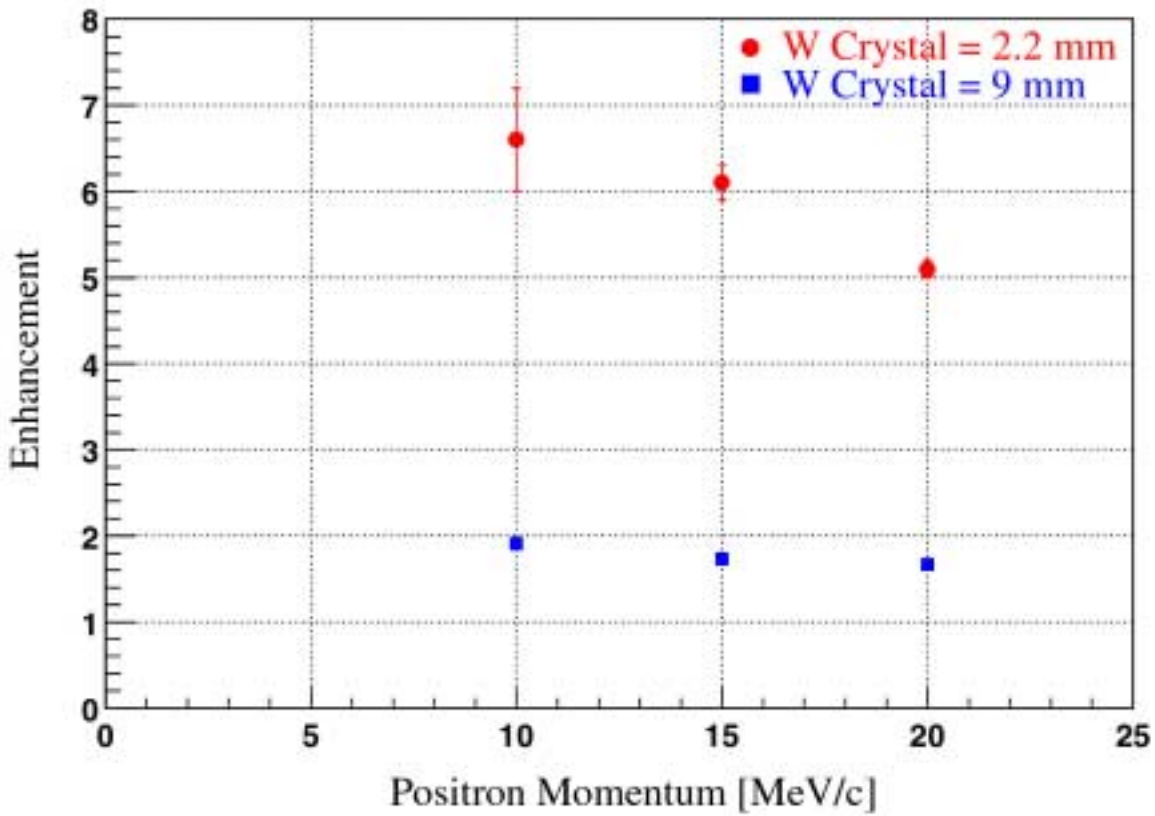


(Fig.5.)

Cf. Lindhart Angle: ~0.4 mrad
Multiple Scattering Angle: ~1.3 mrad@2.2mm, ~2.8 mrad@9mm

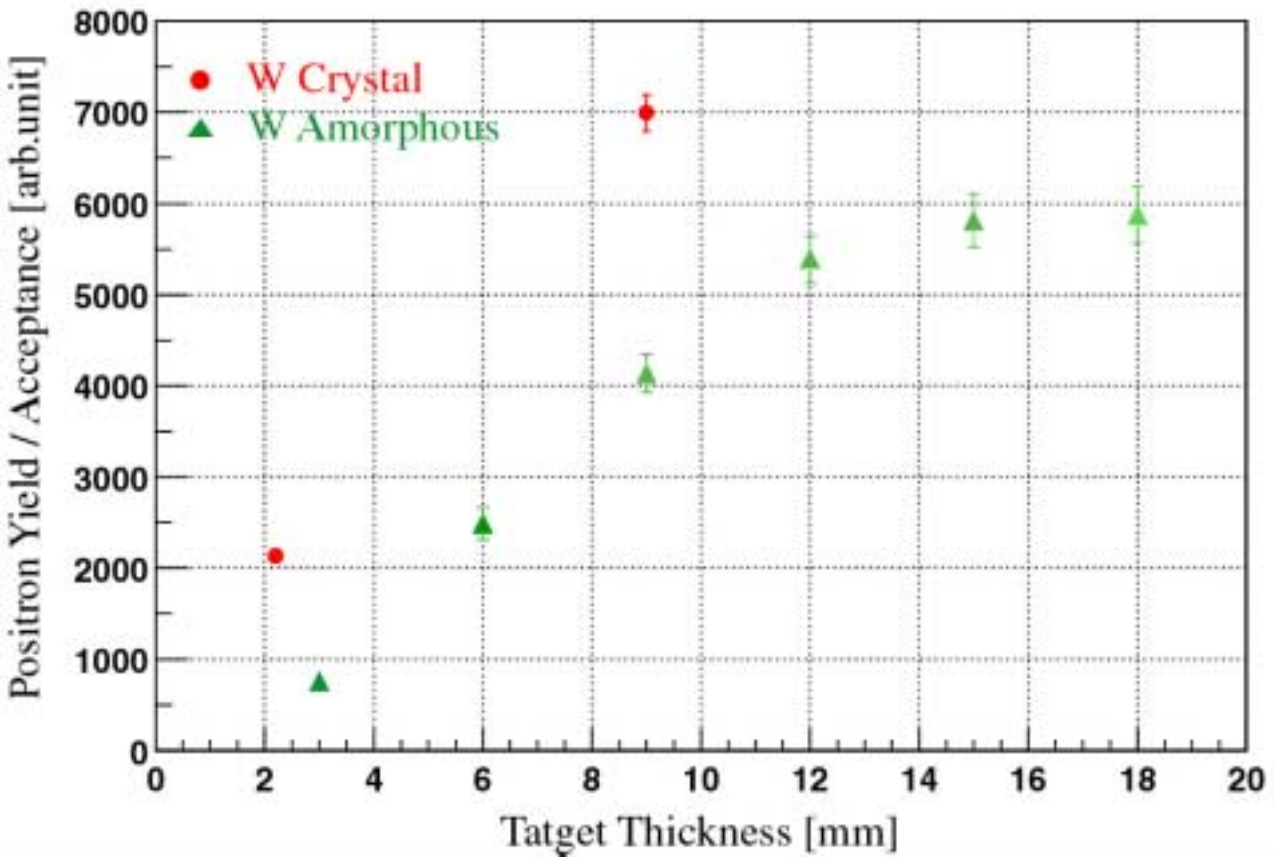
(2) Enhancement

Def. The ratio between yields from the oriented (On-Axis) and disoriented (Off-Axis) W crystal axis <111>.



(Fig.6.)

(3) Target Thickness Dependence for Pe+=20MeV/c



(Fig.7.)

(4) Comparison with the past experiment

(Pe+=20MeV/c)

Month Year	Place Accelerator	Energy [GeV]	Target [mm]	Enhance ment
Mar 1997	KEK Tanashi Branch, ES	1.2	Wc(1.2)	3
Apr, Jun 1998	KEK Linac	3	Wc(1.7)+Wa(7)	1.4
Nov 1998	KEK Tanashi Branch, ES	0.6, 0.8, 1	Wc(0.4, 1.2, 2.2)	2 ~ 2.5
			GaAs(0.36) Diamond(1.1)	
Sep,Oct 2000	KEK Linac	8	Wc(2.2)	5.1
			Wc(2.2)+Wa(5,10,15)	1.2 ~ 1.9
Apr 2001	KEK Linac	8	Wc(2.2)	5.1
			Wc(9)	1.7
			Wc(9)+Wa(2,4)	1.2 ~ 1.3

(Table.1.)

6. Summary

1. The enhancement of the positron yields for Pe+=20MeV/c,

Thin W crystal (2.2mm) -☞ 5.1 times
Thick W crystal (9mm) -☞ 1.7 times

has been observed in the 8GeV electron beam. (see Fig.5)

2. As the momentum becomes low, the enhancement is getting larger. (see Fig.5,6)

⇒ Advantage for the capture efficiency of a Linac positron generator (∵2)

3. The enhancement decreases as the target thickness increases. (see Fig.6, Table.1)

4. The enhancement increases as the incident electron energy increases. (see Table.1)

5. 9 mm-thick W crystal is comparable to 14 mm-thick W amorphous, which is the optimum thickness for the positron production at the KEKB injector Linac. (see Fig.7)

⇒ When the energy of an incident electron beam becomes high , it is expected that the positron yield increases. (∵1,4,5)